6 CONCLUSIONS AND RECOMMENDATIONS

The results of this survey provide a comprehensive characterization of physical habitat in the Lower Green River. These data were collected using methods that are consistent with previous surveys conducted upstream, which together provide an accurate and detailed baseline from which to assess further habitat changes.

Several important insights into the current status of habitat conditions in the Lower Green River were gained as a result of the survey:

- **Instream habitat quality for juvenile and adult salmonids in the Lower Green River is significantly impaired.** Decades of population growth, land use changes, and human alterations of the channel and floodplain have greatly simplified the instream and riparian habitat in the survey area. This survey systematically characterizes habitat impairments that are considered a primary factor of decline for salmonid populations in the river (Kerwin and Nelson 2000). Addressing the general lack of habitat diversity may be challenging given land use constraints, the observed channel confinement, lack of potential sources for future LWD recruitment, and modified sediment transport characteristics in the Lower Green River.
- **The channel is confined throughout the Lower Green River.** A nearly continuous system of levees and revetments incrementally constructed over past decades for flood and erosion control purposes prevents channel migration and limit instream and riparian habitat diversity, complexity and connectivity.
- **Bank armoring, particularly riprap, is extensive along much of the Lower Green River.** This armoring serves to limit channel migration and sediment supply processes in the River. Results of this survey indicate that this armoring is highly visible in areas with urban development in close proximity to the river channel. Based on a review of King County records, it appears that extensive rock armor is also present in many other locations in the Lower Green River where it is less visible due to deposition of sediments and vegetative overgrowth (Schaefer, personal communication) While the presence of armoring is necessitated by urbanization and development along the river corridor, its presence also allows further encroachment and armoring nearby. In many areas, even without the armoring, channel migration is precluded by urban land uses in close proximity to the river, although in some locations it may be possible to remove bank

armor in order to restore a more natural channel form and allow some degree of channel migration to occur.

- **Habitat types are generally homogeneous in the Lower Green River and off-channel habitat is limited.** Glides are the dominant habitat type in the survey area. While the sinuosity of the Lower Green River has not changed substantially in the recent past (Collins and Sheikh 2003), there has been extensive reduction in and isolation of off-channel areas of the river. This has further contributed to increased habitat uniformity in the Lower Green River.
- **The dominant pool-forming factors are manmade structures.** Riprap and bridge abutments were the dominant forming factor for 31 of the 43 (72 percent) pools surveyed, whereas LWD was the dominant forming factor for only two pools. Because there is little potential for future channel migration or natural woody debris recruitment in most of the survey area, the best way to increase pool frequency in the short term would be by deliberate placement of wood, and in the long term by restoring riparian habitat where such interventions are not precluded by existing land use constraints. Without such habitat restoration efforts, instream habitat complexity is likely to remain low.
- **Limited amounts of spawning-sized gravel are present in the upstream portion of the Lower Green River.** Most of the spawning-sized gravel occurs in Reaches 1 (RM 32 to 26.6) and 2 (RM 26.6 to 19.1). This limited distribution is likely due to the low channel gradient of the Lower Green River downstream from Reach 2 and the reduction of flow volume and sediment supply stemming from the diversion of the White River into the Puyallup River in 1906.
- **The connectivity between the riparian zone and the instream habitats is severely impacted by the levees that bound much of the Lower Green River.** The levees limit the opportunity for overhanging vegetation and LWD recruitment in the area. However, in several locations these constraints have been alleviated by flood control facility repairs that included setting back segments of these facilities landward from the river.
- **The riparian zone of the Lower Green River is dominated by invasive species and lacks native vegetation.** Invasive vegetation is extensive and limits colonization of the riparian corridor by native vegetation--especially tree species--which could effectively provide shade, cover and a future source of wood.

- **Numerous outfalls of varying sizes enter the river from both banks.** The types and level of use of these outfalls were not determined in this study.
- **Some water withdrawal pipes were found, but it is not known whether all of these are permitted by formal water rights issued by the Washington State Department of Ecology.**

Based on the observations made during this survey, further study is recommended to investigate several aspects of habitat quality in the Lower Green River:

- **LWD source and recruitment.** The sources of LWD occurring in the survey area are largely unknown, except where it has been deliberately placed by King County and other entities for habitat restoration purposes. Monitoring or tracking of woody debris recruitment in the various reaches of the Green River could be used to investigate the connections between particular riparian zones to pool-forming wood.
- **Extent and degree of chemical contamination.** Another important aspect of habitat quality that is recommended for further investigation is the effect, if any, of the numerous outfalls on water and sediment quality in the Lower Green River. Contamination from these outfalls could have direct and indirect impacts on the salmonid populations utilizing the area. This will be evaluated as part of the Green-Duwamish Water Quality Assessment to be issued in 2004.
- **Invasive vegetation.** The abundance of invasive riparian vegetation is a concern, particularly the presence of Japanese knotweed. This plant is fast-growing and although it had never been surveyed in the study area, its broad extent in the survey area was not previously known. In the future, the location of Japanese knotweed and purple loosestrife, should be monitored closely and actively controlled.
- **Habitat restoration and conservation opportunities** were identified during the field investigation. When these areas were identified from the river they were recorded in the DGPS. More often sites were identified at the end of the field day by combining impressions from the river with observations of the aerial photography. This allowed the team to expand their considerations beyond the channel and adjacent riparian zone to the adjacent floodplain. Areas considered to be conservation opportunities had excellent habitat existing quality and generally did not present obvious opportunities for restoration actions. Restoration opportunities were identified where adjacent land use appeared to be compatible with actions such as the setback of banks, reconnection of side channels, or restoration of riparian conditions.